

NEW EXPERIMENTS
AND USEFUL
OBSERVATIONS
CONCERNING

Sea = water

MADE

F R E S H,

According to the
Patentees Invention :

In a Discourse humbly Dedicated to His
Majesty, the KING of GREAT
BRITAIN, &c.

By *Nehemiah Græw*, Fellow of the Colledge of
Physicians, and of the *Royal-Society*.

The Eighth Edition, May the 22th.

L O N D O N,

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EXPERIMENTS

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TO THE KING'S

Most Excellent Majesty.

May it please Your Majesty,

TH E making *Sea-water* Fresh, hath of late been much discours'd of, and is of great Consequence, not only with respect to *Merchant-Ships*, but also, as I conceive, to your *Majesties Navy and Garrisons*, and to *Sea-port Towns* in all Parts of the World, where good Water is wanting.

All that is proper to be said upon the matter, will lye in making good these three *Assertions*.

I. *That Sea-water may easily, safely, commodiously, in sufficient Quantities, be made fresh for all common Uses at Sea.*

II. *That so done, it is as wholesome to be drunk, and us'd about Dyer, as any other Water now in use at Sea.*

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III.

III. *That being so, the advantages are such as will much more than countervail the charge and trouble about it.*

For the Truth of the first, we have the Reputation of the Gentlemen who have your Majesties Patent for it, and their Interest also to assure Us. By an Instrument scarce a Yard over, which may stand under the Deck of any Ship, or very well in the Cook-room, and all Smoak and Fire avoided; they can make about ninety Gallons in twenty four Hours: Which at the largest Allowance, of three Quarts to a Man, being kept at constant working, will serve about an hundred and twenty Men, although two Quarts a day, or three Pints, in time of Scarcity, is counted a good Allowance for one man.

We are likewise assured, that it may be done with ease and ordinary attendance: for although the Sea be Salter in some places than in others, yet the Operation is the same; neither is there any difference betwixt that which comes first, and last. And whatever is to be put into the Engine with the water, may as easily be done, as Salt or Oat-meal into Pottage: So that one Man may serve both to make the Drink, and for other uses of the Ship.

By Mr. Boyle we are also assured, *That Sea-Water thus made fresh, is as wholesome to be Drunk as any water about the Town, in its best Condition.* And by an Ingenious Physician of the Colledge,

a proper comparison hath been made betwixt *This* and the best *Water*. And so many of the Colledge as were desired, have not doubted to give it under their Hands, *That they were satisfied of the wholsomness of this Water*.

Notwithstanding which, to give the World a little more express Proof of the matter, I shall, with Your Majesties leave, undertake the same; which I think I may the more properly do, because I have no share either in the Profit of it, or in the Credit of the Experiment.

Now, all the Signs, which either *Physicians*, or common Experience, have given of the best *Water*, are these; viz. *Clearness, Thinness, Sweetness, Softness, Lightness, Durableness, and Pureness* or *Simplicity*; with all which good Qualities, if this *Water* stands in the first rank, I suppose no rational Man will further dispute whether it be good, or no.

The *Clearness* hereof, although it may be pretty well observed in a good *Flint-Glass*; yet I consider'd, that as there are degrees of Heat and Cold, of which our Bodies being unsensible, can only be judg'd of by a *Weather-Glass*; so there may be degrees of Perspicuity, which the Eye, unless assisted, will not easily reach; as may appear by this easie Experiment.

If a few drops of *Claret* be put into *fresh Seawater*, (such as is made by the *Patentees*, and with which I made *This* and all the following

Experiments) they will give it a kind of *light Hiacyinthine Red*. But if the same quantity of *Claret* be drop'd into as much *River-water*, and that after the *Water* hath stood in a *Cistern* to settle a considerable Time, it will look muddy, as if a drop of Ink had been put into it; the *Claret* discovering those *Opacons Parts* which before were not easily discern'd.

The same is likewise an Argument of the *Thinness* of this *Water*. As is also the Preparation of it by *Fire*; for the very *Boiling* of *Water*, is one way recommended by *Hippocrates*, and commonly used for the *Attenuating* of it: that is, the *Separation* of any *Gross* and *Heterogeneous Parts*, which swim therein, and upon *Boiling* use to *subside*: and the greatest part of *Rain-water*, which is as *thin* as any, is *Distill'd* from the *Sea*.

Its *Sweetness* recommends it, both as to the *Smell* and *Taste*; for the best *water* hath no *Scent*, neither hath this any. And so for the *Taste*; 'tis true, a little *Alkaline Salt*, in the Opinion of some *water-Drinkers*, gives a kind of *sweetness* or *savouriness* to *Water*, as *Salt* to their *Pottage*; for which cause, I have known them to prefer *Pump-water* before any other sort. But the best *Water*, and that which is generally, both by *water-Drinkers*, and others, most esteem'd, is no otherwise *sweet*, than in being very *soft* upon the *Tongue*, and rather *insipid*; and such is this *Water*.

Neither

Neither doth it excell in *sweetness* or *softness* to the *Taste* alone, but also to the *Touch*: of which quality *Dyers* and *Laundresses* (who are very Critical at their *Fingers-Ends*) make the best Judgment in mixing their *Water* with *Soap*. But a different degree of *Heat*, or proportion of *Soap*, will alter the case: And therefore, to make the *Tryal* exact, let half a Pint of *Pump-water* be warmed to a convenient degree, and half a *drachm* of *common Soap* dissolv'd therein: in doing of which, it will be very difficult to raise a good Lather: the *Water* underneath it will look muddy and unequal, as if it were *curdled*, and when the Lather falls, it lies on the *water*, or any thing it is put upon, like *Grease*, yet feels *harsh*.

The same quantity of *Soap* and *River-water*, and the *water* heated to the same degree, make a high Lather, and that in a short time, and the *water* also under it is equal and *clear*.

In all which Respects, this *Fresh Sea-water* doth not only equal that of the *New-River*, or *Thames*, but excell it: For besides, that it is rather *clearer* when the *Soap* is dissolv'd: it also makes as strong a Lather, in a shorter time, and with less *Soap*: insomuch, that the woman I caus'd to make the *Tryals*, and compare them, not knowing whence I had any of the *waters*, guess'd that above a pound and a quarter of *Soap* would not go so far with *Thames-water*, as a pound would do with this *Fresh-sea water*.

Another Circumstance is, That if the *water* be extraordinary good, it will make a very good Lather without being heated, which this *Water* will also do.

This same *Water* is also as *light* as any common *Water* whatsoever; as may best be prov'd by a *Water-Poise*, which the *Italians* commonly use when they would try the *lightness*, and therein the *goodness* of their *Water*. For this Purpose, I mark'd the Neck of one with several Degrees equally distant, immersed it in the seven following *Waters*, wherein it sunk less or more, according to the *gravity* or *lightness* thereof.

In the *Pump-water* in *Chancery-lane*, (a *heavy Water*) it hardly dips to the first, or lowermost Degree.

In the *Pump-water* in *Christ's Hospital*, just to the lowermost.

In the *Conduit-water* in *Cheapside*, to the second, or near it.

In *Thames-water*, *New-River-water*, *Water* distill'd from *Spring-water*, and in *Fresh-sea-water*, to the third, or thereabout. So that it is as *light* as common *water* distill'd.

Neither is there any *Water* more durable or uncorruptible: for, all Corruption in *Water* sheweth it self one of these four ways; either by some ill *Taste* or *Smell*, or by becoming *muddy* or *turbid*, or by gathering some *Skin* or *Bubbles* at the Top, or by letting some *Sedement* fall to the
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the bottom; none of all which happeneth to this *Water*, tho some of it hath been kept, both in and out of the *Sun*, for nine months; and without all doubt, would continue so much longer.

The last mention'd quality of the best *water*, was, its *Purity*; that is, *Simpleness*, or *Homogeneity* of *Parts*.

I deny not, but rather contend, That there is a certain *aereal Nitre* incorporated with all *Water*; of a different nature from *Nitre* commonly so call'd, and such as by no means yet known, can be visibly separated from the *water*. From hence chiefly it is, I conceive, that *Water* obtains its *cooling* quality; and that when it *freezes*, it is not because it is then only impregnated with this *Nitre*, but because then the *Air* being surcharg'd, throws off a greater quantity into it: As when *Water* is sweeten'd or season'd with a little *Sugar*, it doth not follow that there is none in it, because not enough to make it *Candy*. So there is of this invisible *Nitre* in *Water*, always enough to season it, tho not to make it *Candy*, or turn to *Ice*.

Now allowing this *Nitre*, that *Water* which in all other respects is the most *simple*, is also justly to be esteem'd most wholsom, and always hath been so. For, as the *Humours* of the *Eye*, which is the *Instrument*, and the *Air* the *Medium*, by which we discern all *Colours*, ought to be themselves perfectly *transparent* & *colourless*; so *water*, which is only a *Vehicle* to our *Food*, should

should be it self the most simple, and freest from all manner of Qualities', besides those proper to it as *Water*. For if it be desired at any time to be imbued with any other *Quality*, it is with respect to some *medicinal use*, and not common *Diet*.

Now this *Purity* or *Homogeneity* of *Parts*, doth eminently belong to this *Fresh-sea-water*, as I shall make it appear several ways : and therewithall, shew the reason of its other good *qualities* ; especially of its *Softness*, *Lightness*, and *incorruptibility*.

And first, the reason of its *Softness* is its *Purity* ; or its being undefiled with any kind of *corrosive Salt*, whether *Alcaline*, *Marine*, or *Acid*.

For upon *evaporating* of any hard *Pump-water*, most *Spring-waters*, and *River-waters*, in a *Glass vessel*, or one very well *glased* ; it is evident, that the former contains a considerable quantity of *Salt* : a *Gallon* from the *Pump* in *Chancery-lane*, which is the *saltest water* in this *City*, will yield near three *Drachms* ; not of an *Alluminous salt*, as is commonly thought, but an *Alkaline*, with the *Taste* and other *Properties* of a *Lixivial salt*.

That *Spring-waters*, though they yield more or less of the same *salt* ; yet in a far less quantity, and that *River-waters* yield the least of all : Of which three sorts of *Waters*, the first are the

the *hardest*, the last the *softest* of any in common use; yet excelled by *Fresh-sea-water*, as appears by one of the fore-going *Experiments*.

Neither is there any *Marine-salt* herein; for, whereas half a Pint of this *Fresh-sea-water*, or of *River-water*, and half a *Drachm* of common *Soap*, will of themselves make a very good *Lather*; if but twelve or thirteen *grains* of common *salt* be added to the *water* before the *soap* be dissolv'd therein, it will *curdle*, and the *Lather* fall like *Grease* upon it, as if it were some *harsh Pump-water*.

Nor yet any *Acid*: for, if you put but seven or eight drops of *Oyl of Vitriol* into half a Pint of *River-water*, though you increase the former quantity of *soap*, yet it will never make any *Lather* at all.

Or to come yet nearer; Should any suspect that some kind of *Spirit of Salt* may come off with the *water*; if but seven or eight drops of *Spirit of Salt* be put to half a Pint of *River-water*, it will, in the same manner, hinder it from making any *Lather*. Nay, if but two or three drops be put into it, they will have the same effect.

So the reason why *Fresh-sea-water*, as prepar'd by the *Patentees*, is so extream *soft*, is its *purity*, or freedom from all manner of *Salts*, save only that *Aereal Nitre* which is common to all *water*, and chiefly contributes to its *cooling* quality.

Or

Of if any one should be so pertinacious, as to say, that yet there may be one *Grain*, or part of a *Grain* of *Salt*, or one drop, or part of a drop of *Spirit* of *Salt*; should thus much be granted, then in the same quantity of *Thames-water* there is as much, or more; this being a *softer Water* than even *Thames-water* it self.

The purity of this *Water* is also argu'd from its *lightness*. The perfect Dissolution of any *Salt*, or *Earth*, in *Water*, in never so small a quantity, adding weight to it. So, for Example, if half a *drachm* of common *Salt* be dissolv'd in a Pint of *River-water*, the *Water-poise* will dip no lower into it than into any *harsh Pump-water*. So that in a Pint of such *Water*, there is about half a *drachm* of *Salt* and *Limy-Earth*, more than in *River-water*: for, although such *Water* be as clear or transparent as any *distill'd Water*, yet in the Evaporation, some portion of *Earth* is always precipitated together with the *salt*.

So likewise, if half a *drachm* of *Oyl* of *Vitriol* or *Spirit* of *Salt*, be put to a Pint of *River-water*, the *Water-poise* will dip therein but to the same Degree as if the same quantity of *Salt* had been put into it.

Since therefore the *gravity* or *lightness* of *water* dependeth upon the Dissolution of more or fewer *Salt*, *Acid*, or *Earthy* Parts therein; and that *Fresh-sea-water* is rather *lighter* than *River-water*, and as *light* as any common *Water* distill'd,

distill'd, as hath before been prov'd; the one is as pure and free from all kind of *Salt*, *Acid*, or *Earthy Parts*, as the other.

From whence, and from its being void of any *taste* or *smell*, 'tis also easie to conclude, how it is so *permanent* and *incorruptible*; for in this *Case*, there can be no *Corruption* without *Fermentation*, nor any *Fermentation* where there is no *Sulphur*, nor any other *fermenting Principles* to be any way discover'd: So that as the *Simplicity* of this water is the reason of its *Duration*, so this, with the *Premises*, an evident *Proof* of its *pureness* and *simplicity*; which still may be further confirm'd by the following *Experiments*.

Let about half an *Ounce* of *Syrup of Violets* be dissolv'd in half a *Pint* of some *harsh Pump-water*; in a short time the *water* turns the *Syrup* to a *muddy green Colour*: This I have known to happen to some *Apothecaries*, as much to their *loss*, as their *wonder*, from whence it should proceed. But the *Reason* was, though they took sufficient *Care* in picking their *Violets*, yet not in the choice of their *water*.

Put a few *Drops* of *Oyl of Vitriol*, or *Spirit of Salt*, to the same quantity of *River-water*, and then let the same proportion of *Syrup of Violets* be dissolv'd therein, and it presently turns *Purple*.

But if the *Syrup* be dissolved in *River-water* alone, it turns neither *green*, nor *purple*, but
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holds its *blew Colour* perfect; and so it doth the like if it be dissolv'd in *Fresh-sea-water*.

Observing this, I proceeded to make the like Experiment with *Claret-wine*, which I mix'd with several sorts of *water* in some good quantity, as I did the *Syrup*; but without any discernable difference between them.

But, considering that the *colour of Claret* being very full and strong, might require a much greater proportion of *Water* to over-rule it; I put three Spoonfuls of *Pump-water* into a *Flint Glass*, and drop'd into it not above seven or eight Drops of *Claret*: which being well mix'd, I perceiv'd, that in a little time after, the *Colour*, instead of being changed, was wholly vanish'd, and the *Water* become as clear as before the *Claret* was drop'd into it. The *Alkaline Parts* in this *Water*, destroying the *Acid*, and therewith the *colour of the Claret*.

The same number of Drops, being mix'd with the same quantity of *Lambs-Conduit-water*, in a *Glass* of the like Metal, Bigness, and Shape, the *colour*, in a short time, did almost, but not wholly, vanish.

Mix'd in like manner with *River-water*, it gives a few *Permanent Rayes of Red*, but muddy, as was before observ'd, and is here again to the present purpose.

But being mixed in the same Proportion, and *Glass*, with *River-water* distill'd, gives it

a *light, clear, and permanent hyacinthine Red.*

And the same curious and durable *Red* it likewise imparts to *Fresh-sea-water*.

From whence, and all that hath been said before, it appears, To have the *clearness* and *durableness* of *Spring-water*: the *lightness* or *softness* of *Rain*, or *River-water*, the *sweetness* and *simplicity* of that which is distill'd, and in a word, all the good Qualities of the best *Water*, without any bad one: Which may serve to satisfy any reasonable Man, not only to make Tryal of it, but also to prefer it before any other now in use at *Sea*.

Yet because Men will hardly be brought to leave a known Road, though a bad one, for a better unknown, till they see some Body go before them; therefore, to discharge all manner of Scruple, I must not omit to add, that there are several Persons of Quality, and others, who have Drunk often and liberally of this *water*; and though not much used to drink *water*, yet have receiv'd no Prejudice thereby. And amongst them, some *water-Drinkers*; whom I take to be the most proper Judges in the Case, and who give the Character of it, *To be very wholesome*; and that it will quench the *Thirst*, as well as any other ordinary *water*.

The Feazibleness of making sufficient quantities of *Sea-water fresh*, and the *Wholsomeness* thereof, being granted; The Advantages which will

will arise from the use of it at Sea, are very obvious; with respect both to *Profit* and *Health*.

And first, as to *Profit*. Suppose the Voyage to be made to *Surrat*; for which, one Butt of *water*, for *Drink* alone, is the ordinary Allowance for one Man. The Quantity being always laid in, not only according to the length of this or any other Voyage, but also for a Reserve in case of a Calm; which, if it happen not, they have commonly more than enough. So that if we suppose a hundred men to be in the Ship, they will require so many Butts for *Drink*. Whereas, if there be no *water* laid in, but only an *Instrument* to make it, as there is need, The *Coals* to work it a day and half, that is, to make about a Butt (126 Gallons) of *fresh-water*, may be allowed to be something more than a *Busshel*, which will be the most; or for a hundred Butts, to be about a hundred and ten *Busshels*. So that one Butt containing fifteen *Busshels*, a hundred and five *Busshels* will lye in the room of seven Butts. By which means, about thirteen parts of fourteen now taken up for *Water*, will be gain'd for *Stowage*; saying that there must be some few *Cask* for receiving the *Water* as it is wrought off from the *Engine*. And the like Computation, or near it, may be made with respect to any other *Fuel*, which may also be used as well as *Coal*. Besides which, the saving the Charge of the Butts, will be very considerable;

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the Price of a *Butt* being twenty Shillings, being bound with *Iron*.

Besides which, there are other Particulars, relating to *Profit*, and the preventing of *Damages* both at *Sea*, and in *Sea-Port Towns*; upon which, the Honourable Mr. *Fitz-Gerald*, in his late Book, doth very pertinently insist.

I shall therefore conclude with the second great Advantage which will hence arise; and that is, in point of *Health*. 'Tis true, that *Thames-water*, when first laid in, hath the Reputation of no *unwholsome Drink*. And generally, though not always, good care is taken in laying it in, both at the best time, which is at half Ebb; and in case of great *Tides*, above the *Bridge*, sometimes as high as *Chelsey*. And tho it *ferments* and *stinks* in the *Voyage*, yet grows *sweet* again: and, as they say, doth not *stink* all at one time.

Notwithstanding which, there are very few who would choose a suspicious *Water*, that may have *Spring-water*, if they will, or that which is as good; or better, if it be true, which some say, That in a large *Voyage*, even some *Spring-waters* will ferment a little. For the mixing with *Wine*, or any other use, it would be no small Pleasure to the Captain of a Ship, to be sure of that which is the best. And it is as a Rule among the *Sea-men*, That good *Water* shall be valued, and go as far as *Brandy*, when they club together for a Bowl of *Punch*.

In point of *Health* ; Peradventure, while the *Thames-water* is in the height of its Ferment, even the *Sea-men* may forbear to drink it. Yet we have no Reason but to believe, when that is over, before the *Water* be thoroughly recover'd, it often goes down well enough with them ; who living in so thick and moist an *Air*, and having their *Mouths* always fir'd with *salt Meats*, cannot be very Critical either in their *Taste* or *Smell*. So that though the *Scent* and *Taste* of the *Water*, with respect to the *Seamen*, is not much to be regarded, yet their constant *drinking* of a *fermenting Liquor*, tho' but for some days, may be of ill consequence, and for that time, the more encline them to *Caleutures* and other Fevers, especially near the *Line*, where they are more subject to them, and the *Water* to its highest ferment. For the maintaining whereof, there is a considerable stock of *Matter* in the *Water*, how simple soever it may seem to be. Insomuch, that after any long Voyage, it will *burn* or give a *flash*. Whereas *Fresh sea-water*, being free from all manner of *inflammatory* and *fermenting Principles*, it can no way conduce to the production of the fore-mention'd *Diseases*, but will rather prevent them.

But supposing *Thames-water* were always *wholsom* ; yet the *water*, in many other places, where Ships are often forc'd to take it in, is found

to be very bad, and to make the Men sick. An *English Ship*, the *Faulkon*, in a late Voyage to *Surrat*, being upon the Coast of *Malabar*, was there forced to take in Water; of which, the Men who drank, were taken with *Fluxes* and *Fevers* of that ill nature, that of about eighty five in the Ship, thirteen, or near one sixth part, died in a short time; and some languished long under dangerous Distempers.

And sometimes *Ships* are brought to that want of *Water*, as neither to have good nor bad; as in a long Calm: Which though it doth not often continue so long as to Kill the Men; yet, besides the Anguish of *Thirst*, it sometimes makes way for divers *Diseases*, as a *Surfeit*, *Dysenteries*, or *Cholick*, upon the first Immoderate Drinking.

Sometimes also, it is an occasion of great Danger both to *Men* and *Ship*. Not long since, a Ship went to Sea, betwixt *Chester* and *Dublin*, pretty well provided with Water. But meeting with a calm of some Days, the *Passengers* were forc'd to row several Leagues to the *Welsh Shore*; in which time, if a Storm had happened, the *Passengers* had been lost in the Boat, and the *Ship*, in all likelihood, had been lost for want of the Hands that were made use of in the Boat.

Nay, it hath been known, that a whole Ship of Men have perish'd for want of *Water*. About five years since one came in laden with *Tobacco*

from *Virginia*, in which all the *Passengers* were found dead; having declar'd in a Writing which they had nail'd upon the *Mast*, *That they had perish'd for want of Water*. All which *Mischiefs* will be avoided by the constant supply of *Fresh-Sea-water*.

And not only in point of *Drink*, but also in *Meat*; most of which now eaten is extream *salt*. For which, all the Care they have at *Sea*, is to soak it before it is boil'd; not in *fresh-water*, but in *salt*. For if they should use *fresh-water*, they must lay in near double the quantity, the *Meat* being commonly shifted once in four hours for three or four times. They say, indeed, that the soaking of it in *salt-water*, fetcheth out the *Salt* better than in *fresh*. And for the first or second *soaking*, I believe it may; yet also, that a *soak* or two in *fresh-water* afterwards, will do best: Which, to keep the *Meat* from *stinking*, as at that time it is apt to do, may be done so much the sooner.

But many times the *Sea-men* are put to such straits, as not only to *soak*, but also to *boil* their *Meat* in *salt-water*. Which, instead of taking any *salt* out of it, doth rather add to it, because the *boiling* of the *Sea-water* makes it to become *saler*.

Now from such *Dyet* as this, what can be expected, but besides the highest *Scurveys*, a Foundation also for *Dropsies* and divers other
Diseases;

Diseases; of which the *Patients* either dye quickly, or are hereby so far weakned, as with respect to the Publick, to be worse than dead: For a Man that is dead, is but one Man lost; but one that cannot work, is not only lost himself, but also spends upon the Labours of another. All which Mischiefs will be very much prevented, by having of *fresh-water* enough for all Uses at hand.

And this, not only by emendation of bad Meat, but moreover in altering the very way of Diet: for where there is fresh Water, good Victuals may be made at any time without Flesh. This, with Bisquet, Wheat, or Rice, and a little Sugar, or Butter, will make very good Food.

I have thus comprized all that is necessary to be said upon this matter, in as few Words as I could, that I might not seem to mis-spend those precious Minutes whereof your Majesty hath so few to spare: nor should I have presumed to have intrench'd on them at all, had not Your Majesty already judg'd this Subject worthy Your Royal Consideration, for the great Usefulness it may be of to Your *Forts* on *Land*, and Your moving *Castles* in the Sea, where also You are *Sovereign*; and the Advantage it must certainly bring to *Navigation*, that great *Medium* that Unites the far distant Parts of your Empire, and makes the whole World in a manner pay
Tribute

Tribute to the Throne of *Great Britain*. Those that see the Wonders of God in the *Deep*, when they find Relief in a Necessity by which they must have perish'd without this Art; will praise Your Majesty's Goodness and Care, not only of your own People, but of all Mankind, and will justly account it a Miracle, that you have rais'd a never-failing *Spring of fresh Waters* in the midst of the *Ocean*.

F I N I S.

